Evaluation of Different User Input Types in Interactive Segmentation

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Abstract—**Interactive image segmentation is the process of extracting the desired object(s) with the help of the human operator. It is a looping process whereby users are required to provide input until the desired object is segmented. The placement accuracy of the user input will help to reduce the number of loops required. Normally, users are required to place strokes on the foreground and background of the desired objects. However, segmentation algorithms tend to misinterpret the intention of the users although the foreground and background strokes were placed. Therefore, user input constitutes a very important step in the success of interactive segmentation algorithm. Currently, to the knowledge of the authors, there is no research on the use of these different types of input on the accuracy of the segmentation results. Therefore, this paper intends to fill this gap. In this paper, we present a brief review on the different input types that had been used as the initial input and in the refinement process. Next, a series of experiments had been carried out on the use of these different types of user input to study the effect on these common users input types on the segmentation results. The experiments will look into the location, number and length of these different input types using Berkeley image database with the nonparametric higher-order learning. It was noticed that, the location, number and length of the different user input types will affect the segmentation results on complex images while remain consistent for simple images.**

Index Terms—**Image Segmentation; Interactive Segmentation; User Input; User Intention.**

I. INTRODUCTION

Segmentation plays an important role in computer vision and it is one of the crucial steps in pattern recognition. According to Wiki [1], image segmentation refers to the process of partitioning a digital image into multiple segments (sets of pixels, also known as superpixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze.

Image segmentation is used in various domain areas. In medical field, blood cell is extracted from a complicated background and later every cell is segmented into the morphological components such as nucleus, cytoplasm, holes and other organelles [2]. Apart from this, segmentation is also applied in remote sensing data whereby object of interest on the satellite images is segmented based on the input from user [3, 4].

With the advancement of computer technology, image segmentation process can be fully automated. The objective of fully automated segmentation is to reduce the involvement of user and produce more accurate results as comparing with manual segmentation. However, many researchers [5-13] addressed that fully automatic segmentation still exhibit difficulties and cannot provide satisfactory result due to the complexity of the images, especially using natural images. In order to solve this, human operator plays an important role in the segmentation process.

II. INTERACTIVE SEGMENTATION

The involvement of human operator in the segmentation is called interactive or semi-automatic segmentation. Based on the definitions from various sources [5-7, 9, 14-22], it can be summarized that the purpose of interactive segmentation is to extract the desired object with the involvement of human/user by providing a high level or priori information. The general process of interactive segmentation is shown in Figure 1. In this figure, the user places an initial input to specify the background and foreground of the desired object on the image. The segmentation algorithm will produce a segmentation result to the user. The user will then assess the result and the segmentation process will stop if the user agrees on the result. Otherwise, input refinement process, whereby the user is going to enter additional input, will take place. This refinement process will loop until the desired object had been segmented. The ultimate goal of an interactive segmentation algorithm is to minimize the refinement process and segment the desired object as quickly and accurate as possible. In other words, an interactive segmentation algorithm is considered better, in the matter of maintaining the similar accuracy when comparing with another interactive segmentation algorithm, if the number of additional input required is less. The key for a segmentation algorithm to quickly segment the desired object is to understand the intention of the user. In order to understand the intention of the user, the algorithm needs to understand precisely the meaning of the user input. In this paper, an introduction to the various categories of segmentation, followed by input types that had been used as the initial input and in the input refinement process, are presented. The common practice of the researchers in the domain of interactive segmentation is mainly focusing on the segmentation results without a detailed analysis on the effects of these different user input types on the final results. Therefore, this research intends to fill this gap. In this paper, a series of experiments using the common inputs were carried out and the effects on the segmentation results are presented. The paper ends with a detailed analysis and suggestions pertaining to the analysis.